Notebook, N-04-10-16

This notebook covers the period October-December 1904. It contains notes and drawings by Edison regarding storage batteries. Included is a twenty-nine-item list entitled "Experiments on Battery for ESBCo," followed by observations drawn from the results of endurance tests performed at the Silver Lake plant and from the examination of cells used in a Studebaker electric vehicle. Also included are entries regarding defects in the batteries and outlining possible causes for the loss of cell capacity. Inserted into the book are several pages of notes by Edison and an unidentified experimenter concerning the battery tests. The front cover is marked "T.A.E. Observations & Theories." The pages are unnumbered. Approximately 80 pages have been used.

X E-172 N-04-10-16

October 16 1904
Experiments on Battery for ESB Co—

1- Mix with Fe & the dope a little Co(NO3)
Ferrichloroxide—

2= Use in ROH Electrolyte, Niobate K—
Tantalate K— Borowolframate K—
Phosphomolybdate K— Phosphotungstate K.
~~Sulf~~ Trichloroacetate K

3 Precip Bi & Fe salts various proportions
wash free basic salts reduce by H no H_2O

4 Precip Hg & Fe formate salts wash free basic salts
Do not reduce by H. Try various proportions

5 Precip Copper & Fe salts - no H_2O —
Dont reduce by H. Try various proportions

6 = Precip. Copper Fe + Hg Salts wash free basic dont reduce by H — Try various proportions'

7 Precip Fe same way as we now make NaOH, use 7 + 3 graphite + grind same way Na_2HgO_2 — test for Econ + permanency

8 Precip Fe Bi + Hg Salts wash free basic dont reduce by H, Try various proportions'

9 = Fe + Bi. precip from salts various precipns no Hg, use NaOH Electrolyte as Na gives amalgam with Bi. Hal Bancroft decomposes

10 — Small ordnance Cells' 3 each Regular pressure on Corrugating Die — 3 with increased pressure + 3 with maximum pressure permissable commercially

11 = Test cell always kept supplied with H_2O_2 =

12 Test cell Reg KOH unpurified no H_2O_2 used but put in after Cl_2 taken out

13 = We use $FeSO_4$ without recrystalizing we use practically the whole of the crystals hence sometimes we will get in batches more or less impurities which will go into the different mixes in different amounts & while these impurities may not hurt the iron pocket they might be very detrimental to the nickel by being transferred across in the Electrolyte so we must look out when we make iron for the nickel as well.

14 Its probable that the trouble due to Hg globules coming out & amalgamating with the plates & making vibratory crosses that some metal can be added to the iron that forms a strong amalgam with it & not decomposable except at very high temperatures, much

higher than it would be when the water was too low — at same time the mercury on chg would distribute itself between this metal & the now + on dischg would pass over & be held firmly by the metal. Bismuth makes a shiny alloy — Copper ditto, also Silver, probably Bi would be the most promising — its lower with the Elec series than Lead or Copper,

15 = Run endurance Cells 3 filled with dots of shavings of our regular rubber, -

16 Jwa suggests that deep seated sulphur from the Rubber may come out into Electrolyte & get oxidized to Sulphate then the SO4 ion would get concentrated in the nickel pores & being extremely inert in KOH would plug up pores. A Reversal would throw the Pb load out, but it seems to me it would show up as high resistance ~~to~~ in any event putting the Cell in Warm water for 48 hours should dissolve it out & thus accomplish what

Reversing does - Try it. =

17 = It is likely that hydrated Sulphide of Nickel mixed with graphite 8 to 2 will on Reversal (10) K ion on Ni + changing of KOH, be got to work - possibly Juste maybe small —

18 To rejuvenate batteries
Try 10 hours placing cell in Water at 160 Fahr — Not good

19 Ditto 150 Fahr + reverse at 50% over normal for 10 hours - changing KOH, - Reverse only against Can pretty good.

20 = Logic - Reversing charge on Ni (10) K ion on nickel, always rejuvinates a battery once good but which has lost some capacity - If a battery originally lacks capacity by reason of unequal filling of the pockets at the factory Reversing the Ni against the Can does

or Aluminum etc gets deposited in channels or else throws gas polarization —

not increase it capacity at all. Therefore reversing the 1st argument the Can. cannot cause mix to make 2nd contact in fact its tendency to increase itself should make it worse. Therefore the conclusion is irresistable that the drop in capacity of a battery after running a few months is due to some chemical action which the K ion on reversal decomposes + throws it out into the Electrolyte — or heat alone increases Ja on battery + Cause from Circuit

Now what is the chemical action its probably Combination of an acid radical with the $Ni(OH)_2$ to form the plain salt or a basic salt, Such as a Stearate Silicate, Aluminate or basic Sulphate etc

What is the source of the radicals —
CO_2 from the air, is the principal radical —
SO_4 from oxidation of sulphur from the Rubber —
Aluminum, Phosphoric, Silicic, Chlorine, Iodine, Br, SO_4 from the Electrolyte, Stearic a from something
Unknown radicals from the iron which must be impure — Unknown radicals from the Mercury in the iron — Radicals from the Nickel plating from impure nickel salts, and anodes + Radicals in the $Ni(OH)_2$ itself

21= Madelaine Battery is three good-
fifteen nearly 2 yrs - all 20 mos. why —
is it because now was made in those
days which did not have the unknown
radical that hurts the nickel ?? —
or was the rubber diffrent or is it stiffer
caps, or is Ni free of Radicals, or is it due to Briquettes

21= Test a good cell and a bad cell (in
one originally good but has lost say
20% Cap. r.h.) — both on a constant
Res starting discharge at 50%
above normal, a plot curve to
see if Resistances of the two
Cells are marked diffrent,
This is not brought out sharply
in discharge at constant amperes
Did this show its not Res but MOH
out control somewhere.

22= Make several maintenance cells 2 of each
with Ni mix screened to sizes, from say 40
60 80 100 120 140 160 180 —
+Run say 20 times + then test,

23- In the Ni plate may there not only be the simple insoluble salt such as $NiCO_3$ brought about by migration of the CO_2 Radicals but possibly a basic Carbonate, $3NiCO_3$ $NiCO_3$ — also there may be double salts formed with K such as K_2CO_3 $NiCO_3$ etc Even a soluble K salt may combine with an insol Ni salt to give a partly sol resultant again the pores may get saturated with a salt such as Sulph K or this salt being poorly sol in 20% KOH precips out & so clogs the pores that the pocket receives only a partial charge during the short Charge period & thus the pocket loses not unlike those which will the pores are open — Varying porosity by changes of pressure in the pocket would vary as to deleterious effects of pores being filled with Crystals, again Concentrated Solution within the pores of the K salt of a radical might produce entirely different secondary reaction on the nickel hydroxy

24 = Newexperiments with chemicals which may affect the NiOH, endurance [illegible]
2 of each –

Borate K – Phosphate K, Arsenate K,
Aluminate K – Manganate K, Iodide K,
Chlorate K – Perchlorate K, Hypochlorite K,
Formate K – Sulphide K + H_2O_2 –
Silicate K, Antimonate K – Stearate K,
Oleate K – Albumate K – KOH boiled in
our rubber, & used darkened – also
old rubber used in IC cells – also regular
hard rubber. use chips, Mexican asphalt
or gilsonite boiled in KOH, + solution used,
Our regular black iron boiled in 28%
+ then diluted to 20% —
Comm'l OH in Sol — Tartarate K –
Niobate K, Zirconate K –
Barium Carbonate boiled with KOH + sol. used.
Lime ditto – Strontium ditto Magnesium
ditto Magnesium OH ditto, Uranium OH
boiled – Succinate K – Oxalate K,
Sulphate K – KOH, boiled with filter paper
+ Solution used.
KOH, Boiled with lime – KOH boiled with BaOH
ditto with Strontium – Sulfate K KCl –

KBr - Kcy - Keyanite, K Sulfocyan,
KNO_3 K nitrite, K Tartrate, KOH boiled
with Litharge, Stannate K, KOH boiled
with CdOH - Zincate KOH,
KOH, boiled with COOH, KOH boiled with NiOH,
K_2CO_3 — NH4 - NH4 Carbonate,
KFl. Potassium Sulphoferrate,
(Chaulot's reaction) — K Ferrate,

25 = Meike Pocket of Carbonate Ni
8 & 2 grafite, well rolled;
3.2 gramm: — ~~One part put~~
~~1 NiO, packed between 2 grams~~
~~of Chromic Reduction~~
Charge one diamant wire in 20% KOH, with Hydrogen pole, Charge the other with Oxygen pole
again a wire in another Cell

with 20% 1.5 OH = ~~then~~ then put, the Oxygen charged one, ~~each~~ against 2 chgd nons + discharge — (Charge 15 hours at 200,)

~~Hunt to a action~~ Now reverse the one that was chgd on Hydrogen pole on new KOH, + charge it on Oxygen pole 15 hours — then put between 2 chgd nons + disch —

If Results are poor —

do the same chg down again in KOH with new potato, 1.75 Fahr — with wire —

+ disch Reg Temp between nons plates —

26 ~~3 H2O~~ 3 H_2O_2 CO_2 + 5 H_2O.

Sol in warm Ammonium Chloride —

See if any solvent will differentiate between active + inactive $NaOH$.

(10) Separate by Solvents in 2 parts or two separate

27- Take some well known good Ni Mix
Expose about pound to atmosphere
where there are no chemical
vapors and make 2 tests
Nickels Every week & see if
long Exposure to air causes
it to become inert -.

28- Use good mix let cups remain
under jar in CO_2 & Run two every
3 days. Use 12 cups.
Then, will determine Carbonating
diff. as above with H_2O on sponge in
addition to CO_2 =

29. Make some Ni_2O_3 by igniting Nitrate
then reduce this by a reducing agent
& make good it goes to green by
several reducing agts to H_2O_2 etc.
Hydroxylam & sugar dont work see 2652 2653
but something may work, H_2O_2 dont work
see 2654

Standard Nickel
inside cup reversed, from outside

2733 orig 92 99

Chg 200	43 h	Run 150	528		101	103	9
"	18	" 500	478		102	105	10
5th run "	22	500	500		104	108	12
		Dup	or. original	98	106		
1st chg 200	43 h	run 200	589		105	110 ?	10
2 "	26	500	561		102	102 ?	
4th "	22	500	550		112	113 ?	well
		Dup	orig	93	101		
1st chg 200	43	run 200	545		102	104	9
2nd	18	500	475		103	105	10
5th	22	500	576		105	106	12

Possibly mix can move on inside cup when it swells & cannot when there are burrs?
This would cause mix to even up
589 is very high for Standard Ni
What was weight, it was not recorded
Was outside cup reversed also
if not the burrs would interlock & make a tight crimp —

Remarks from S. L. Brooks -
See 2445 — "Bad effect of Bi on Fe?
2621 - get the Voltage Curve - see if it aint low -
See 2645 KCl Electrolyte, good - note no small swell -
2733 - note burrs outside give fine results at high rates - even with poor Ni (Ni) Standard Ni - This poly
Something to do with face contact & different conditions at the burrs of the mix - Note that Standard mix never runs so well as Reg mix want it due to long use, Reconing, & Exposure to air - Joe says it due to coarse stiff mix & it wasn't selected as a high mix —

What is 2756 - 2757
2764 - 2765 oxidized except OK at normal but only 71 to 92 at 500 rate, ??
Explain this — even Reversing
2 days didn't improve high rate but very little,
perhaps Reg cups are cleaned by Electro-etching & freed from dirt & oxide more etc,

* Displaced KOH,

Evidently reversing after Ni gets swelled & usually only serves to close up coherent channelling by giving stained lake place before the Ni has got soft, it's likely that Plates stained slay in KOH for 1 hour or more instead of 15 sec to get well soaked in KOH before electrolyzing would to them will be gas formed in the most closed spaces.

Formation of Ni by Hydrogen from Oxalate, mixed with graphite rolled worked in 25% KOH, at 190 Fahr with by Current density to form an active Ni,

What is 1858 —

See 2083 — why was result so good & swell so great, — was it viscosity of the oxygen & growing — that swelled it — the pressure due to swelling that brought up to such pressure & raised capacity —

* See 2105 — Reversing the Lead with Cad Nitty made it worse but 2106 Stays worse chg'd Reverse before put on charge & then gave 4.50 to Vault on first chg see it also 2107 — Rev before chg

2142 2143 what is the $Ni CO_3$
~~4 KOH, [illegible] $Ni CO_3$~~
$Ni CO_3$ 1 vol 3 KOH 6 vols 1 hour

2189 — 10% NH_4HCO_3 another Case of fine results by reversing 12 hours pressure to fast run See Curves what weight of Cake — Dont record

also 2201 Reversed that before charge fine results — Dont record. 33 chg 12 —
also 2244 2245 — 2247 not [illegible]

See 2209 — Swell, strange?

* 20 to 80 mesh new process ni Pll/2 treated
(5 mesh in NH4OH Continuing NH4SO4 Sulfate.
Washed + Dried 842 grs wet wt
gave for 3:2 as high as 645. 7 well
56 — 1st 565 — 20th 502. 158 ots
The Drop washed 80 mm was not good
470 1st 387 5th — 5 well 25 5th —

NH4 gave best results

Regular wet wt

2321. orig 85 95 94
— 7th 107 104
23 swell —
3.45 — 236 mg.

2322 Drop of 2321 Reduced 24th 5% before chg.
orig 87 95 99
— 3rd 110 104
23 swell —
3.95 — 3.95 mg

7 gr NH4OH 2 grms 4% fine graft present + cc 33% Rem. rolled added 1/2 grm
Coarse graft. rolled + dried

See 2222 2223 2224 is this 17% fine mass
graft added and titrated or then 3:2 Cake
weighed out — ? —

NH4 — added, seems improves all products,
See 2227 — 2236 —

See 2234 — Why so low ? notice improvement
made by Coarse graft. — diff. 2235
See bad effect of finest graft. 2243 ——

See 2251 2252

Note 2263 —
~~Rem. [illegible] before chg [illegible]~~

Reverse before chg — 2255 — 2256 — 2257 —
2285 — 2321 + 2322

Note diff. between 2303 2304 +
2305 2306 bad
~~up to 2335 bad~~

To test a fully charged resin after chg put
in water + add Bromine — which lift it + side —

Reverse before chg - All reversed cells show higher Cell no
~~before change~~ chg on 1st chg
2339 - good - 2340 good, 2357 2359

~~[illegible]~~

See high output from 2.87 grams
1232 — 1233 20% ~~[illegible]~~
~~grams~~

Note - ~~1486~~ 1486 1487 - little loss at high rate, Hi mix ground fine. + 1488 1489 ground Coarse + Sandy
What are 1090 to 1094 —

Conclusion of KOH in potash ~~gas~~ gas out,

Can it be that Sulphide radiant precipitates Lime, but sto in Nickel which Chloride does not,

Showed nickle bond Calk with Lime Pot Sto in Nickel + use Electrolyte with Sulphides in

Note 1069 — where 4.5 Ni in 35% KOH went to 720 + then KOH chgd to 20% & went to 710 738 730 — showing that only effect of 35% is to produce a gas insoluble ~~[illegible]~~ film so graphite in the Carbon is good — in something else

Off charge for a period & then resumed

1731-Bi 660, after rest 713 1 month

1737-Bi 574 — after 1 month rest 640 —

~~2643-Bi 1047 after 21 hrs 946 hr rest~~

See 2685 — where after 8 Runs in 21% — put in 33% & Runs no improvement.

2378 = Why did Reversing have such a bad effect, forced reduction Evidently did something bad — Dropped from 432 to 293-220

Pocket Unsigned in Ni NH Jul 1, 2379 ~~[illegible]~~ Ni NaOH Chloride S.T. 222-2389 — ~~[illegible]~~ ~~[illegible]~~ ~~[illegible]~~ ~~[illegible]~~

Dry mix — No paste 5% $NH_4{}_2CO_3$
3/2. Reversed hot 12 hours
in 5% KOH Charged 3 times.
33 charges ~~[illegible]~~ Stated

1st 567 —
567
602
612
667
652
7th 675
22 684
~~28~~ 535
31 598
33 571

Calliper 1st 85 98 95
120 111 112
reference

47 small

Wet mix was No

1st 355
2nd 325
3rd 270

orig 85 98 100
3rd 101 105

Not reversed

Poston made final cell. Nothing mix when testing with 35% $NH_4{}_2SO_4$ Mg = Then was made
Second charge

One of the best cells is.
3/2 Dry mix made. No paste.
5% $NH_4{}_2CO_3$ 8 g 2 fine graphite,
Ll5. 2189 —
Discha 150 — highest reading
684 — 33 Runs — good at end
Charges, It was reversed
12 hours in glass in hot
plate in 5% KOH charged 3
times before it went on
Charge — Was the Carb KOH
dried out or decomposed out,
~~Explain 22 01 this was a~~
~~reverse before charging~~
~~5% KOH, Dry mix~~
~~Went over to 708 had 3:2 cells.~~
~~but says 1:9 NH_4OH_2 —~~

Here is a Case -

2305 - $Ni C_2O_4$ + graft to precipitate treated with 4 3% KOH. Hypod for 3 days + well washed rolled 20 min moist with 1/2 cc. KOH to 4 1/2 gr ammon

3.12 Dry

to Volt.	84 Calipers
385	swelled to 124 on 3rd run
215	Swell of 40
155 -	dishgd 150

A Duplicate. Reversed Pat 12 hours in 5% KOH.

to Volt	82 Calipers
480	120 on 3rd run
477	Swell of 38
500	

dishgd 150

What did reversing do-make pores or throw out some radical or concentrate the KOH so cell could be formed once for all - (10) all in to $Ni OH$ which is a conductor, or after the film on graft + gained Gellen Contact

Uroto. ~~2442 & 2443~~

Gen Exploration 2471 – [illegible]

put in separately or precipitated
with mix of separately the strange
+ good result.
it guess equivalent for 3.4 218 packet
884 the Vault, apparently books
show its a pp mix with graphite.
Then needles of BiOH added or rolled
10% needles – ½ cc 21% KOH. 52 swell
on 36th run, 4 still good –
notice big drop at high pressure at 2477

Perhaps BiOH is slightly soluble
in KOH or it might be beneficial
in solution. The BiOH put in cell
as a precip – I notice Bi had
peculiar effect on the wall
in book somewhere –

BiOH doesn't seem do any good
in KOH Sol

Cumulative

Glycerine added to mix makes it gas bad

2404

1.065 gm glyc

487
422 18 swell
372 –

2405 –

Dip Reversed before put in chy

457
396 20 swell –
352
340

1% glyc 2406

410
335 – 21 swell –
293
282

Dip of 2406 Reversed before chy –

510
462 19 swell –
430 –

2498 – 100 gms paste 50 gms Na_2CO_3 + 10 cc NaOH, mixed the NaCO dissolved ← mixed with the paste. Dried low heat. washed free alkali. chy-Reg

212
157
172
65 –

Dont say if there is graphite.

Notice 2536 – Extra heavy plated
Caps Reg Stuff

352	150 rate	3.6 –
305 –		
280		This shows something
75	500 "	in Coverage or Contact
260 –	150 rate –	31 small –
305 –		

Loss Capacity Reg M test pockets
8th Runs

2586 –	1 1/2 loss	8 1/2 loss	2 1/2 loss
2587	2 1/2 loss	6 1/2 "	2 loss
2590 — +	1 1/2 gain	7 "	1 "
2591 — +	1/2 gain	7 "	2 gain –
2594	1/5 loss	9 "	2 "
2594	7 1/2 loss	10 1/2 "	
Etc	1 1/2 loss	1 1/2 gain	

average 5.12 loss average 1.16 gain –

2675 2676

Mixed Pockets with 3.12 one with fine mix other with Coarse mix on 20 mesh.

	fine	Coarse	
1st	552	520	500 Rate 458 –
10th Run	537	502	" 275 –

This would show that fine mix Best as Coarse mix not enough surface for the rate deck circulation with the big particles –

See 2781. Where other Experts made with this $\frac{30}{1000}$ deep corrugating die
Standard Ni –
at 100 rate 495 to 500
500 383 to 325
Possibly 30% drop Swell 12 Cents
scarcely any swell at Edges –
When put in 33% didn't improve
any

Notice 2681 2682 – with deeper
Concave die, $\frac{35}{1000}$ – Went down to 151 to V
on 12th Run at 100 rate, 6 Cells are very bad.
Especially at 500 rate, possibly the 16
Swell on Edges was Convex – Total
Swell 39 – Now what is cause of
this –

9 pockets see 2701 were made up
Standard Ni – Various weights Standard Ni
Eight runs taken, – dividing grain in milligram grams

	to V	
2.7	423	15.66
2.8	435.5	15.55
2.9	447	15.41
3.0	476	15.53
3.1	485	15.64
3.2	498.5	15.58
3.3	519	15.72
3.4	534	15.70
3.5	595	17.00 ?

Shows increases directly as to weight
Except 3.5 –

I notice another Cap with burrs outside that runs fine Especially at high rate.

100 Rate 528 Another 589
500 " 500 100 Rate 550
500 "

another
100 rate - 545 - swell 12.
500 - 516

All above standard Ni. No 2733-

Next page Reg Ni - burrs & space inside.
100 Rate. 528 - another 100 rate 523
500 — 450 500 " 425 -

Now why so this - so it because mix could flow evenly with burrs out & thus get more even contact,

Only 6% diff bet 100 & 500 rate burrs out
& 17% " " " burrs inside.

Also notice that capacity was better because standard Ni dust gives as good Cap as Reg Ni

2752. Standard Ni 3·2 one end pocket

Empty –

100 rate. 466
500 – 158 Cups

2753

100 rate. 450
500 " 232.

The low rate does seem to affect it much as S Ni is low about as 1.8-0.V2 but at high rate, but on high rate loss is 56% – as against 3·2 in burn outside 17% with Reg Ni & 56% S Ni with soft end

Explain this – Swell 15/100 about.

Kerosened cups dried on heater –

Standard Ni 3·2 – shows

26% loss Get 100 + 500 discharg – Reg rate about normal

See 2762 –

When cups oxidized, Standard Ni – 3·2 at 100 455 which is normal! but at 500 rate only 92 – as loss of 82% –

Why does it not effect the low discharge rate, is it due to polarization

~~What is 1866 to~~

Special No 2 Eyelet cups shows small drop 6ft 100 & 500 probably because smoother allowing mix to flow better 11% drop — but genl mix used 3:2 and only gives 488 average to V which is low —

2 nickels of Ni in cups dipped dry into naphtha, against 1 standard Fe
100 Rate 990.
500 " 917 — about 8% drop

When dipped Kerosene. 10% drop from 100 rate to 500 rate — Standard Ni —

2853. Genl Ni 3:2 100 Rate 520
500 308

after 8 mins 1/2 gram K_2SO_4 put in Electrolyte
100 rate 500
500 204 was as low as 167 —

How about this —
What did SO_4 ions do —

$(NH_4)_2SO_4$ from Bi ammonium salt

Arsenate K dont seem do harm —

With perforation about closed
100 Rate 527 —
500 " 235 — 60% drop —

See 2920 - 2921 - } Explain it.
2922 2923 }

2944 — 11 pockets made Glen ridge
before January deepened cups
100 rate - 533 - 55
500 " 533 " "
Dup Why is this

100 rate 502 }
500 " 483 - } -

Those made June 7. 2948
100 Rate 590 100 rate 545
500 550 Dup 500 " 492 -
Why

KBr = HgBr in aq KOH
HgCl "
HgI Soluable KOH.

Different Chem on Electrolyte of
1 Run Charging 24 h + 2 Runs 3 3/4 h
Run at 200°.

Charged 280,
Standard Fe 415 2 Marks

Rsq-	KCl	KClO	KBr
1006	1080	1150	1132 S
780	753	783	803
653	751	775	823 !

ZnO	Benzoica	Al_2O_3	KI
1105	1105	710	354 S
557	730	506	160
200	440	420	168. !

$K_2C_2O_4$	K_2SO_4	C_2H_6O
1145	1133	1017
703	798	727
623.	718	733.

Ammonia	$K_2B_4O_7$	Oleica
942	1067	717
412 S	700	477
200 !	373	267

Turpentin	Aniline oil	Pyridin
1137	1123	637
747	731	220
417	340	157

All the other solutions much lower –
+ they showed it on 1st charge they must

the iron as was afterwards found out
but how did they hurt it on the
first charge, certainly not on charge
must have done it on discharge
the acid now passing to the iron
Note the high economy of KBr - 82.3%
amp efficiency
Density ratio is equivalent to 28.8 amp
for 2.18 — Has insolubility of HgBr
HgCl. anything to do with this —
Hg | sat KOH —

We should make some small lead
cells with gradually increasing
amounts of KCl KClO & KBr.
up to a point where pockets
are attacked —
Also some check cells with
unplated pockets —

Note 1723 - Ni prep by BaOH ?
Ni(Cl solution)
842 mix 3.2 533 75 rate 492 150 mx
It was NiCl precip by BaOH —

884 - off thick [illegible]
[illegible] 9.2 grams [illegible] [illegible] 1/4 —
chg 150 dec 50
on 5th day 12.15 to [illegible]
Today this amount of Nickel has
given 884 would give 552
[illegible] Manganese, Chromium
Present Nickel only gives 550 at best.

The Rule after a pocket has run
for some time is 20% pulling it
in 35% makes it worse
see 506 507 at high rate,
There are exceptions, see 558 —

Apparently Quality of ore in
old Workings Gets Wet, without
Hope from the dust falls
off in Capacity like modern
ore with dust in it
Hawkshead Roques & Madeline bulling

In the new Iron process where $FeSO_4$ is fused in NaOH the resultant short sum quite evidently within there is some Compound formed by action of NaOH on the impurities or something that possibly might be burnt out or drawing by [illegible] the clay oxides in the iron before Reduction by Hydrogen.

How would it do to Volatilize FeCl into an atmosphere at Red heat containing H_2O Vapour Result very fine Oxide + HCl. Which Can be used in H_2O Gas be used again.

Make set pockets diff. to 132 grams $NaOH_2$ vary by 20. up to 150 mesh — hours not 1 hours —

Mix $BiOH$ not needs but approx with Black non no Hg — roll mixt rather dry — make 7% black 1, 20% $BiOH$.

Mix Black now with dry Cub Bi dry —
" " " " Roll with KOH.

Put six stainless cups in 20% KOH. for continuous Charging. to 100cc of 20% add ~~[illegible]~~
3 5 7 10 15 25 grams KCl —
ditto KBr — do KI — This will tell us the maximum we can use of KCl KBr & show what KI does —
be careful not let solution get Carbonated perhaps best change it every 2 or 3 days — better use Closed box + Caustic Lime to get rid CO_2

Also try above on KCl. with Cups not plated —

Paint made of Cups before making up with 3:2 Reg with Platinum Chloride thick + reduce up H, to get a platinum surface see about polarization, economy etc —

~~Make a Paste~~ Fill a thin cup with paste of NiOH & red cross in H. to get a sponge if it cracks use mixture of graphite & paste, after get sponge – saturate successively $NiSO_4$ + boil in hot KOH, until pores full. Then see increase of weight & Run Reg —

Duplicate the spongy Ni Cup & use $FeSO_4$ + pp by Heat KOH + a Sol Mg Salt, until pores full —

Put up some cells with following Electrolyte, say 3 grammes of ~~Ag~~ Each – ~~Ag~~ ZnOH ZrOH, BiOH, Al_2OH, CO_2 in form K_2CO_3 – CoOH, CaOH SnOH, Silicate Soda – MgOH. CuOH, PtOH, 200 mlg Arsenic acid. K Sulphite, Na Hyposulphite 6 grammes filter paper boiled in KOH, – PbOH, put seperator now boiled in 21% 3 hours

~~PtOH~~ KTi CeOH. Tantalate of K – AgOH. HgOH. DiOH. ThOH Phosphate K. Phosphite K. Boil the KOH for 10 minutes with 20 grammes Reg Prem Mix – don't get KOH Carbonated

Boil, KOH 10 minutes, with 10 grams Barium Carb,
" " 5 " Soft gasket Rubber

5 grms HgCy — 100 c 21% KOH,
5 " K Fluoride,

Try for Velande prepared Oxychloride of Copper

1 Cell 1 grms KCN 1 grm KPer 1 KFl.

Make Cobalt by iquite Oxalate, reduce by Hydrogen + use req amt HgO dope

Ditto without HgO dope —
see Economy + Capacity.

Make Cell unplated pockets see Economy —

Make Cell pockets entirely of Nickel got by plating, see Economy

Reg test cell very complicated
Electrolyte. 20% KOH 100 cc To
which add 1/2 gram of following
KCl – KBr. K_2SO_4. Ketatite, $KClO_3$. K Formate.
These are all soluble salts with KI

Dette's solution –
1/2 g KF – K Phos KBO_3 K_2CO_3 K Citrate

1 Cell 5 grms Sodium Acetate 100 cc 20% sol

There may be something that improves the cell at the same time something that is deteriorating it – The improvement reaches a limit while the other goes on & a point is soon reached when the cell goes bad –
This is so with the Land cell –

Possibly we should have following new groups

3 Cells without any rubber - glass rods
1 old glass bottom, 1 no side separator
use glass pins or substitute, Reverse
group separately - jar 30 amp 24 hours - Note No 2

Group 15
Reg E18 - M group reversed in a porcelain
2 jar 175° Fahr pure sheet nickel.
30 amp 24 hours, assemble with
New group washed in a jar reg —

Group 16
Another E18 M group reversed in a
3 porcelain jar 175° Fahr for 48
hours, against CP Nickel - 30 amp 24 hours
" USE same new same backing
as in No 2

4 Another E18 M group reversed in a
porcelain jar against CP Nickel sheet
30 amp 24 Hours — use an new group
which has been made Cathode 30 amp
24 hours 175° Fahr
Mellen base —

5= E.18 H.I Group reversed on porcelain jar 175° — 30 amp 24 hours, Iron group made anode, 150° Fahr 30 amp 24 hours —

Notes on defects —

1= Notice several cells just assembled + welded on our long heat line, liquid comes up through rubber gasket at poles

2nd Notice sometimes gas bubbles comes up through gasket of poles, which stops when new gas top is lifted

3rd notice many gas tops stick, others have no up-down play — find Ends spring were too long — grooves wrong

Notes of
Test of good + bad Cells from Shuckburgh
Wagon — Cell 1100 1854 etc.
Calliper plates made of stiff tin from 6
plates bad cell 1260 D —

Before Run

87	95	95 —

Decently grooved when we got them

after run

93	96	96
97	98	98
96	97	98
95.3	97	97.5 average

Calliper of original Plates

Bad Cell

82	85	85 —
86	91	90
82	88	88
85	99	90
75	85	85 —
82	91	97
87	90	88
84	85	88
83	90	90
84	95	95
83	89.9	89.4

Good Cell

92	92	93
93	93	92
92	92.5	92.5 —

after Run
the marking up

Packets leaked from

Bad Cell		Good Cell
317	Rates same	463
265		457
295		400
292.5		440

(Then stuff taken out bad cell & put in new packets & rinsed)

391
491
483
388
516
448
457
442

75 closing rate, 3.2

There may be error here as perhaps original pkts only had 2.8 or so + 42 would be wrong - However stuff was not washed -

Bad Cell - pockets as on top was continued to Run them

		Swell,	original 85-90-90
317		87-91-92	
265			
295			
303			
275			
307	88 92		
244	90-93		
422	Reversed hat 24h at 500 - 16th change		
	95 95		

possibly of NiO_2 is formed originally in 33% it somehow [illegible] the original $NiOH_2$ that it runs different from what it does when originally run in 20% & that therefore 33% has no effect, for instance an original might be run 21 made unchangeable by OH and only, however in 33% it might become a higher oxide & be changeable & be changed back but if run 21 & it got weaker it could not be changed, so might be higher by 33% formerly 40% and so my work cannot infer [illegible] & [illegible] under then 21% when

Other tests confirm this

The swell however is greater after running in 33% —

This would show that it is a question of graphite or that 33% originally used produces a different Condition as to the graphite or acts chemically on something in the $NiOH_2$

Sec 2685

27 gr Reg. test run
10% Kott.

1st	412	91 98		100 Run
7th	420	93 95		
8	421	95 97		
33% put in			Chg	Run 100
9th Run	458	93 98	18 hour	"
10th "	446	94 98	16 "	"
11th "	406	110 102	63 hours	"
12 "	346	104 107	17 "	Run 500
15 "	477	115 104	3 days	" 100

This shows that 33% has nothing to do with the Capacity of the Nickel at least after it has been run some time in 20% — possibly something might have got into NiOH pores of the particles — prevented 33% from getting in or doing its work — The reason it swelled afterwards was due to viscosity making gas pressures yet it didn't get better by the swell —

2142 - 2143

Carbonate of Nickel 3:2

having 25% less $NiOH_2$ in
giving in a Reg 2.56 NiOH
& in 2142-3 1.92 "

2143 - gives 716 to a Volt if calculated by weight of $NiOH_2$ as compared to Reg No. 5.12 - This is a dry mix - probable reason is that the CO_2 went out & gave porosity & the graphite didnt get covered with sticky film of $NiOH_2$ = Work this up -

swell -	Original	90	94 94
	1st	128	110
	2	129	117
	3rd	127	114

Possibly the Current with very weak KOH, or K_2CO_3 could be used to get CO_2 out without making a swelling $NiOH_2$ =
This idea of getting porosity & clean graphite is OK if can get the bulk down to let out pockets —

Notice small concavity made by Crumpling die –
The wall is considerable. It is a wonder it ran so well – Dry mix means no water or KOH, but Na_2CO_3 powdered very fine, if it could be got Coarse like reg. NaOH mix – then Crushed to get no fulms and it would have been a Gitter, but the wall of fine will render the use of any Salt of Na insurmountable

Possible a Cylinder say 1 ft dia 1 ft thick of mix might have CO_2 percolated out but when it dries probably NaOH would dry & close the pores –

Notice 1697 – Ni Cl₂ precip. by $Sr(OH)_2$ 3.2

1st	451		orig 33 94 72	
2nd	606	5th.	115 103 103	
7	609		Lines in pretty good.	

See 1848 = 3rd run Equivalent to 700 per 3.2 grams Reg

Strength 6.2 gm and ideas to make a set of tests using Insoluble Compounds of Nickel 8.42, in grid or get indicator up by Recovering with very weak acid or KCl in Water to just make it Conducting Very phos, Boric Benzoic acid Phosphate Hi – Arsenate, Borate, Fluoride, Oxyfellinde, Tungstate Molybdate, Manganate, of Hi Sto. promptly Mly for Cmbs – CHEMKY.

Hg O Voltage

Note. 2107. Reversed 12 hrs flow
Equals 742 for a
Regular it was reversed before
Jumping was it 21% — swell is
little liquid — 2 2.12 gm NaOH.
Thus series of stuff very good
Several trials — graft pp with NaOH,
Alcohol dried & reversed. 17% coarse graft.
2105 of which 2107 is dup. but had coarse graft. —

2149 — graft pp $NaOH_2$ & 6% HgO

		.75	V	
1		720	387	113 118 100 101
2nd		657	375	115 112
3rd		637	345	118 114
				121 113

Notice by left V = .75

& When Reversed before chg ?

1st	.75			
1	737	445	119	117
2	675	407	121	116
3	670	358	124	118
4	585	317	124	118
5	605 (Burned 24 hr)	302	124	120

Evidently Mercury is bad ?

See 2180 also Rev — 10% pyrogal — NaOH much
worst bad but not so great chg
before .75 + V

Note. 2183. 2184 2185. 2186 —
the chemgeney —

~~See 2199~~

No Mix — List of things that might be used to stick gelatin on that might not be affected the Nickel + stuff got out by washing

Quinine trihydrate secondary minor
~~Tungstate Aluminum Barium~~

Gelatinum — Acetate Cadmium
Allophanate Sodium
" Glycerylt.
Allylate of K
Aplin
Articine neutral sulphate drier to horny mass
Caproate K Jelly
Chrysanisic Acid Co + Cu Salts.
Cumylate K
Ferrocyanide of Sn Zn
Cyclamen -

Note

Note why not use an organic
Insol Mn Salt Mix with Gr ofite &
then instead of acting on it by
K ion as Cathode where it
Anode & Dissolve the Radical —
it might just serve ill —

also Carb Ni mixed 8+2 proof &
Subjected anhydrous Ethy gas then
if it form EtH_4CO_3 heat it the above
but CO_2 as EtH_4Co

Elemi resin Ethy Cinnamate to gelatinous

Formate of Tin "
" Uranium "
Gallotannate Sb "
Oxy quanine. "
Dichlorohaemine jelly
Morandin
Nitrosachanone glutinous, soft
Parellic acid gelatinous
Picric acid, "
Picrates "
P...
Salicetin "
Sr Solanine, sol al — salts of 3 diffs, gelat
Sulphoglutinic acid, made by
Sulphuric anhydride on steam of Naphthalene
glutinous.

Tetrachloronaphthylsulphurous K
salt gelatinous
Sulphate alumina tetrabasic jelly
coherent,
Amylsulphate of Al — gelatinous
Stannate of ammonia "
Molastannate K

Sulphate Amylamine,	gummy
Amygdalic acid	"
Arsenate Tin	"
Acetic Chromium Benzoic acid	"
Camphoramide.	
Chloroacetic a	gum –
Chelidonine acetate	gummy
Citrate of Aluminum	gum –
Mono citrate Ba	gummy
Filicic acid Na Salt,	"
Furfurine phosphate	"
Malate of Aluminum	gum –
Mannitic acid	gummy
Sulphomalybdate Cerium Salt	"
Morphine pyrotartrate	gum
Dimethoxalic a	gummy
Hypophosphite Aluminum.	gummy
Phosphate Titanium	"
" Zirconium	"
Pyrophosphamates of NH4	"
Pytoracemic acid B Kind forms gummy Salts	
~~Cy~~ Ethylsulphurica Aluminum	gummy
Metalactamic a	"
Glycotartaric acid	"
Sugar Molasses	

~~Dracto~~ Varnish Like Chem

Conine acetate.
Hydrochloïdic acid Na salt Sol Alp
Phosphomolybdate Manganese. Varnish.
Morphine Acetate "
Pelosine "
Quinine Borate. "
" Chlorate "
Rubian "
Shellac "
Selenate Cerium "

Nov 1 1904

Make test cell with graphite HNO_3.
~~[illegible]~~ Warm for long time in 33% peroxidation to Elements, permitt.
then wash water long time, dry &
then use by rolling — try 40% also.

Possibly Rig cup soaked in 45% KOH, warm for several days more
several. Then, soak in water for various
times, run in 20% — with swell —

Make 3. test Ni, both cups double
to see how stiffness goes —

Make 3 test Ni — Split graphite, —
60 to 80 mesh NaOH, glycerine &
Smalle tumbling Oil — soak central
glycerine cut, — 1st graphite with glycerine coat
NaOH, then put in graphite

Little, lightly press, soak little glycerine
cut, dry clean dry then smooth die
then Corrugating die —

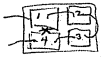
Also Try on turntable Key bottle one, Various solutions in high grade alcohol in which are dissolved Salts & Other materials, Citrates, chlorides, acetates, protates, are being thrown through often ~~good~~ MoH produces called to graft goes on, -

Possibly our Crumpling Dies too deep Concavity might make a machine not so dependable for purposes

It would be a good thing if we could Coat the graphite with Nickel Richard by H, to very fine velvet powder or Thimble the powder with a binder to Coat graphite with it i then Coat MoH with an alcoholic Salt + stick graphite on then the mix would have so much friction it could not flow -

See 15 pages back

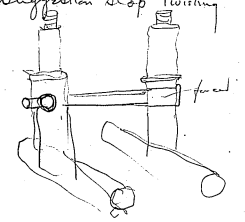
Notes Battery defects – Nov 2 1904



4th = found 4 cells
front waverly – 3 gave
What appeared reversed – slight voltage
but its only Voltage by Through Cur
No 1 gave 1/2 Capacity found nut at
* Oberon between Cond – moved
Cam & it commenced smoke –
it crossed the Cells – took it out
ok = probably put in in pkg room

5th = Cell in Waverly apparently
reversed it was short circuited –
took Cell up stairs, short it no
result put Current on & Voltmeter
+ twisted pole post Cross Came out
probably all but recent crosses
is twisted pole pieces in assembly
for shipping – some device must
be got up to stop twisting =

6th = Suggestion stop twisting



See 1961 —
N. OH paste with 10 to 15% o
Hg Oxalate, mixed Dry 484 2
3.21 — 218 Reg mix — not washed
Even with Hg Oxal grow 485 —
pwell 14 —

What is 1974
See 1991 941 graf fine
185 Sup
190 185
280 — 190 150 220
283

find Rec with definite pressure
of Reg Ni mix 100/1000 thick
Some sizes as [illegible]

Notice in many Cases a long
Change after lot good deal of
[illegible]
2106 – This very [illegible] before
Chg – 32 gr. 660 [illegible]
[illegible] 17 [illegible]
500 111 [illegible]
435 – 4 days.
but there [illegible] Exceptions [illegible]

[illegible] Effect
[illegible]
21/[illegible] to 23/[illegible] – [illegible]
[illegible]

[illegible]
the effect [illegible] Cell [illegible]
disappears – Cell go bad
The question arises why do Cells
run higher on 3 5/8
vs 4 [illegible] Rec to [illegible]
in [illegible] [illegible]

amounts formed & this of itself gives better conductivity -

Next

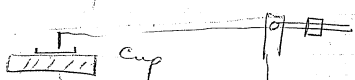
Experiments to try on pockets.

Charge | 100 ma |
200 | 350 ma | 15 hours
Then open + cut away surface
10/1000 all over pattern
ibatch glass + pour out
to see where Blue or
rather green shows —

Charge 6 pockets 15 hours —
then discharge | Ten
minutes normal | 30 min
| 1 hour | 2 hours | 3 hours
| fully discharged
Want to see when black
on Cup disappears

Make a presser contact

platinum wire wrapped



Measure Cups
new + after use
also block for wheatstone Bridge

Take an outside cup clean in acid, wash well put in ammonia wash well — a pocket Utility Crucible
Then put in KOH ~~and~~ change 1/2 hour then run it against a charged Meter, ~~the~~ what Milliamp hours get, to see if the ~~[illegible]~~ now worned discharge the block film,

Nov 8 1904

At last I have struck the right thing. It has in my way to Evolve distribute the mix in the pocket, if ever the cell run good, if not the cell is lost
Now in Running a battery
We have the 2nd plan of my (1st) the Chemical Mechanical
wherein the mix must on account of swelling make a new distribution of itself in the pocket, now on account of burns, more or less

depth of Corrugation, quality of mix, roughness of Nickel plating etc, the mix in its new condition cannot distribute itself uniformly hence in some cells there will be nearly as low from distribution & in other very unequal. ~~[illegible]~~ as the swelling of the mix is a slow process, the cells will when retarded by burrs etc get more & more uneven & one part will force the cups away from the other parts. Now by strong KOH, we soften the mix, but heat we increase the effect of KOH to soften & if we use Hydroquin in lower surface of pocket will diminish the friction to sliding. hence the mix in act of swelling can flow until if time is given the whole flows out evenly for all acts to produce pressure even hence all in contact & high resistance obtained, in course of time there will be further swelling & by bringing cell to strong

Koff, Kent & Clement, Mr Cochrane
against Com. it is so ordered again
of new reorganization of mgt
takes place for we bring the
case back again. The Industrial
should begin an all calls before
changing originally, —
& though 12 other India Cymbals
were a year or so ago
so set the mgt that Dice wice
remain good for long periods —

Nov 25 1904 Experiments on HgO in KOH — I find that HgO in our 21% dissolves slightly. Red ox disappeared over night, replaced from drops ammonia. Opalescent white precip —

Found that HgO dissolved in 21% KOH. Turns yellow if few drops NH4Cl added —

Ditto of Carb Sod added — Solution warmed —

KCl no effect,
Little KI — Hypophosphite Na, KCy — Acetine — added to 21% KOH dissolve HgO —
also filter paper boiled with 21% disolved CO2, considerable HgO —

If HgO in 21% is reduced by ammonia the solution of NaOH, brings back the Red Color of HgO — or I is fried Cantaray which —
Was using KOH purified by Walton.
Base & Ipe was late Hg(NO3)2,

Cup giving following MAH, gives in E 18 Ohms

to V –	gives in E 18	
555	160	amp
520	150	
485	140	
450	130	
415	120	
380	110	
345	100	
313	90	
281	80	

Aluminate Calcium not decomposed by KOH ditto Aluminate Zinc. Calcium ferrite not decomp by KOH.
Copper Sulphate insol KOH.

Acetone + Ketones of higher fatty acids. cause HgO to dissolve in KOH. Thiosulphate K KCY + IK do the same thing —

[ITEM FOUND IN BOOK]

Dec 13, 04

Capacity of new E 18 cells put up since Oct. 1st, at which time we changed the weights of nickel pockets from 3.3 - 3.55 to 3.2 - 3.4

E 18

Sec. 78	Sec.79	Sec.80	Sec.81	Sec. 82	Sec.83	Sec.84
2-130	1-130	3-120	1-125	1-153	2-140	1-130
1-140	4-162	3-140	2-156	1-159	3-147	1-156
1-147	3-165	1-147	2-159	6-162	1-156	3-159
2-153	2-168	8-159	1-162	9-165	1-159	9-162
2-159	2-171	3-162	1-165	12-168	1-162	24-165
2-162	10-174	12-165	1-168	10-171	9-165	5-168
8-165	5-177	9-168	3-171		10-168	2-171
5-168	5-180		12-174		3-171	1-174
4-171	4-183		8-177		4-174	
4-174			2-183		4-177	
4-177			4-186			

Sec.85	Sec.86	Sec.87	Sec.88	Sec.89	Sec.90	Sec.91
1-125	2-130	1-130	1-130	1-115	1-153	7-171
1-150	1-147	1-156	1-150	1-156	3-165	11-174
1-153	2-153	3-159	3-153	3-159	6-168	19-177
1-156	1-156	3-162	4-156	2-165	15-171	5-180
2-159	2-159	8-165	3-159	1-168	20-174	3-183
5-162	1-162	15-168	9-162	24-171	Power off	Power off
14-165	1-165	8-171	11-165	9-174	40min.	40 min.
16-168	5-168	6-174	8-168	3-177	4 Hrs.	3 1/4 hrs.
5-171	6-171		4-171		before	before
	4-174				Discharge	Discharge
	3-180					
	5-183					
	1-186					

Sec.92	Sec.93	Sec.94	Sec.95	Sec.96	Sec.97	Sec.98
2-144	1-125	1-120	1-144	2-150	1-147	1-153
2-150	3-156	1-135	2-159	24-153	1-153	8-156
2-153	6-165	5-159	5-162	15-156	2-156	9-159
11-156	13-168	6-162	30-165	4-159	10-159	16-162
16-159	14-171	13-165	5-168		13-162	8-165
8-162	6-174	16-168			14-165	1-168
3-165	1-177	6-171			2-168	

[ITEM FOUND IN BOOK]

Sec.99	Sec.100	Sec.101	Sec.102	Sec.103	Sec.104	Sec.105
1-135	1-120	7-162	2-135	1-135	3-130	2-135
3-156	1-140	2-165	1-140	1-150	1-135	3-140
5-159	4-144	4-168	6-144	1-153	1-153	3-156
11-162	19-150	20-171	4-147	1-156	1-159	8-159
18-165	22-153	10-174	9-150	8-159	5-162	11-162
7-168	1-156	2-177	8-153	4-162	9-165	11-165
			9-156	15-165	13-168	7-168
			3-159	10-168	5-171	
				4-171	1-174	
					2-177	
					2-180	
					1-183	

Sec.106	Sec.107	Sec.108
1-110	3-140	1-110
1-125	1-147	3-135
1-135	6-156	1-147
1-140	10-159	4-150
1-144	9-162	4-156
1-147	9-165	8-159
3-156	5-168	10-162
18-159	1-171	10-165
13-162		4-168
8-165		

[ITEM FOUND IN BOOK]

E 27 Cells Vol. 3, 2 - 34

Sec.84

2-216
2-220
2-234
5-238
12-243
7-247
6-252
2-261

Sec.85

1-190
1-238
2-243
7-247
6-252
18-256
4-265

Sec.86

1-210
1-238
2-240
3-247
7-252
15-256
9-261
2-265

Sec.87

1-225
2-234
8-256
5-261
11-265
4-270
1-274

Sec.88

3-238.5
4-247.5
2-252
13-256
2-261
11-265

Sec.89

1-247
3-252
5-256
9-261
6-265
4-270
1-274

Sec.93

1-234
9-238
11-243
4-247
12-252
6-256

Sec.94

1-216
1-220
4-238.5
12-243
5-247
10-252
8-256
4-261

Sec.96

3-195
2-243
6-247
6-252
10-256
9-261
9-265

Sec.97

1-225
2-229
4-234
3-238
10-243
10-247
3-252
5-256
2-261
2-265

Sec.98

8-216
8-220
3-225
2-229
5-234
5-238
4-~~234~~ 243
7-247

Sec.99

11-234
10-238
10-243
10-247
5-252

Sec.100

4-210
2-220
2-225
7-229.5
9-234
13-238
1-243

Sec.101

1-225
2-234
3-238
4-243
20-247
6-252
1-256
2-261

Sec.102

3-210
2-216
1-220
3-225
2-229
2-234
5-238
8-243
7-247
4-252
1-261

Sec.103

1-225
1-229
2-234
1-238
1-243
3-247
18-252
14-256
5-261

Sec.104

2-210
4-216
3-220
3-225
9-229
5-234
5-238
4-243
2-247
8-252
1-256

Sec.105

2-225
2-229
4-234
7-238
6-243
4-247
13-252
7-256

Sec.106

1-187
1-220
5-229
2-234
14-238
16-243
6-247

Sec.107

1-202
1-220
1-229
2-234
3-238
5-243
6-247
14-252
12-256
3-261

Sec.108

1-229
1-238
5-243
15-247
23-252
1-256

Sec. 109

1-226
2-220
1-229
7-234
5-243
7-247
14-252
8-257

Sec.110

2-220
4-225
1-229
2-234
7-238
6-243
9-247
17-252
4-256

[ITEM FOUND IN BOOK]

E 45 Cells

New Cells Wts. 3.2- 3.4
June 25
Sec. 2

3-393
9-400
4-405
4-411
4-420

New Cells Wts. 3.3 -3.55

July 13 Sec.10	July 23 Sec.13	July22 Sec.14	July26 Sec.15
1-337	1-337	1-367	1-360
7-393	1-397	1-435	1-382.5
17-406	1-405	5-442	8-390
6-418	5-412	17-450	3-397
	1-420	7-457	4-405
	10-427	3-465	4-412
	11-435	5-472	3-420
	7-442	1-479	4-427
	2-450		4-435
	1-457		4-442

July26 Sec.16	July27 Sec.17	July28 Sec.18	July29 Sec.19	Sep.14 Sec.20	Sep.13 Sec.21	Sep.13 Sec.22
1-382	3-390	5-375	1-405	1-390	2-412	2-382
2-397	6-397	9-382	12-412	3-405	4-420	9-397
1-405	5-405	8-390	7-420	2-412	5-427	16-405
5-412	2-412	3-397	2-427	9-420	7-435	8-412
3-420	2-420	8-405	2-435	9-427	9-442	4-420
10-442	6-435	2-412	4-442	13-435	13-450	
7-450	10-442	1-420	3-450	2-442		
3-457	4-450	3-427	8-457			
5-465	1-457	2-442	1-465			
	1-465					

Sep.16 Sec.23
1-397
1-405
6-412
1-420
9-427
10-435
6-442

New Cells Sec.24 Wts 3.2-3.4	Reversed ~~NEW~~ CellsSec.26 Wts3.2-3.4
1-337	4-350
1-350	2-360
2-360	9-375
2-367.5	1-382
3-382.5	5-390
1-390	4-397
6-397.5	
5-405	
5-412.5	
6-420	
6-427.5	
2-435	

Reversed Cells Wts 3.2-3.4

Sec.27	Sec.28	Sec.~~22~~ 29
3-350	1-325	2-360
1-367	1-360	10-367
5-375	1-375	6-382
4-382	3-382	3-390
2-390	4-390	4-397
4-397	3-397	4-405
3-405	9-405	5-412
2-412	6-~~412~~	8-420
	3-420	2-427
	2-427	3-435
	3-435	2-442

Sec.32	Sec.33
1-300	1-375
1-312	1-382
2-350	3-397
5-360	1-405
3-375	1-412
4-382	6-420
7-390	13-427
2-397	12-435
	6-442
	4-450
	1-457

G. L. G.

[ITEM FOUND IN BOOK]

Ag – KI pale yellow
KBr yellow
K_2CrO_4 dark red
Ag_3AsO – yellow –

Pb – KI yellow – K_2CrO_4 yellow

Hg – SH + $HgCl_2$ = yellow & red
HgO sol KI – K_2CrO_4 yellow –

Bi_2CrO_4 yellow —

CdS – yellow – a.

Arsenic – $FeAsO$ – yellowish

Sb – Sb_2S_3 Orange

Sn – SnS_2 yellow –

Fe – Ferric formate, acetate, meconate.
Sulphocyanide – soluble red –

Chrom – Bichromate Red.

[ITEM FOUND IN BOOK]

Osmium – $Os(OH)_4$ red

Palladium – K_2PdCl_6 – red crystalline –

Iridium – $(NH_4)_2IrCl_6$ – dark red crystalline pp –

Selenium Red –

Rid tetramanganic – $SrAl_4S$ –

Cerium – Red pp – with $NaClO_3$

Ferricyanide K red,

[ITEM FOUND IN BOOK]

Ly amide in KOH.
Fluffed it up to 60 18 times bulk
turned transparent & partly dissolved
Ly changes color —
.0x no change —
6l ?
5l0 no effect —
6l discolors
Red Red but shift there but partly
decolorized & shrunk —